

THURSDAY, AUGUST 25, 1910.

## RECENT AERONAUTICAL PUBLICATIONS.

- (1) *The Art of Aviation. A Handbook upon Aeroplanes and their Engines, with Notes upon Propellers.* By R. W. A. Brewer. Pp. xiii+254+12 plates. (London: Crosby, Lockwood and Son, 1910.) Price 10s. 6d. net.
- (2) *How to Build an Aeroplane.* By R. Petit. Translated by T. O'B. Hubbard and J. H. Ledeboer. Pp. xiii+118. (London: Williams and Norgate, 1910.) Price 2s. 6d. net.
- (3) *How to Build a 20-foot Biplane Glider.* By A. P. Morgan. Pp. 60. (New York: Spon and Chamberlain; London: E. and F. N. Spon, Ltd., 1909.) Price 1s. 6d. net.
- (4) *Les Aéropplanes, considérations théoriques.* By P. Raybaud. Pp. 24. (Paris: F. Louis Vivien, 1910.) Price 1 franc.
- (5) *Ballons et Aéropplanes.* By G. Besançon. Pp. 346. (Paris: Garnier Frères, 1910.) Price 1.75 francs.
- (6) *L'Aviation.* By Prof. Paul Painlevé and Prof. Emile Borel. Pp. viii+266. (Paris: Felix Alcan, 1910.) Price 3.50 francs.
- (7) *Navigation in der Luft.* By Prof. A. Marcuse. Reprinted from the *Denkschrift der ersten Internationalen Luftschiffahrts-ausstellung zu Frankfurt a. M.*, 1909. I., pp. 46-59. (Berlin: Julius Springer.)
- (8) *Stabilité des Aéropplanes, Surface métacentrique.* By Prof. M. Brillouin. Reprinted from the *Revue de Mécanique*, 1909. Pp. 80. (Paris: H. Dunod and E. Pinat, 1910.)
- (9) *Die Seitensteuer der Flugmaschinen.* By Prof. H. Reissner. From *Flugtechnik und Motorschiffahrt*, 1910, 8, 10. (Munich and Berlin: R. Oldenbourg.)
- (10) *IV. Congrès international d'Aéronautique, 1909. Procès verbaux, Rapports et Mémoires.* Pp. iv+473. (Paris: H. Dunod and E. Pinat, 1909.) Price 8 francs.
- (11) *Bibliography of Aeronautics.* By Paul Brockett. Pp. xiv+940. (Washington: Smithsonian Institution, 1910.)
- (12) *Petite Encyclopédie aéronautique.* By L. Ventou-Duclaux. Pp. 144. (Paris: F. Louis Vivien, 1910.) Price 1.75 francs.
- (13) *The Encyclopaedia of Sports and Games.* Edited by the Earl of Suffolk and Berkshire. New and enlarged edition, in monthly parts. Part i., pp. 80, with numerous plain and coloured illustrations, including article "Aëronautics." (London: William Heinemann, 1910.) Price 1s. net each part.

THE present season has been, so far as aviation is concerned, a record of brilliant successes and terrible calamities. The recent fine performance of Mr. Moisant in flying from Paris to near Dover forms the fourth cross-Channel record, the preceding one being the late Mr. Rolls's flight to France and back without a stop on June 2. Mr. Moisant's performance differs from the previous ones in that he carried his mechanic

as a passenger, and that he steered his entire course by compass, not having been over the ground before. His flight was not performed under by any means ideal weather conditions, for within a few miles of the English coast he ran into a rainstorm, which, owing to the high relative velocity at which the machine was being driven, or, as a newspaper reporter imagined, "with the high wind prevailing coupled with the speed at which the aeroplane was travelling" beat on the aviators' faces and on the machine with the violence of hail. Again, when approaching the English coast, the machine is stated to have been sucked down from 800 to about 200 feet, as the result of air currents set up by the cliffs. And while the Holyhead to Dublin course still awaits completion, it cannot but be said that Lorraine's preliminary flight from Blackpool to North Wales was an excellent performance, and it is quite possible that the Irish Channel may be crossed before this review is actually printed.

On the other side, we have a terrible list of fatalities, and the mere smash up of a machine that has cost hundreds to build has become a matter of such everyday occurrence as to confirm the view often expressed by the present reviewer, that it would have been better, cheaper, and probably quite as quick in the long run to have first got everything done that could be done in studying the problem of aviation by the methods of exact science and to have developed the practical side subsequently.

Mr. Brewer's book has only been out a short time, the preface being dated April, 1910, and yet in his introduction he directs attention to the small loss of life that has been incurred in the development of flying machines. The tide of good fortune would certainly seem to have recently turned, as we have before us records of no fewer than eleven deaths through accidents with either balloons or aeroplanes during the month of July, while the preceding three months claimed a death-roll of twenty-eight or more. The *Standard* of July 13 gave a list of eleven fatal accidents precedent to the death of Mr. Rolls, commencing with Lieutenant Selfridge in 1908, and not including previous fatalities, such as those of Lilienthal and Pilcher, and the death of the Marchese Vivaldi Pasqua has just been announced, following on a series of fatal accidents in Belgium, America, and elsewhere.

The fact that Mr. Brewer (1) has acted as assistant to Mr. Grahame White will probably secure for his book a large circulation, but for the more intelligent reader a greater recommendation probably arises from the fact that the author has concentrated his attention mainly on those features of the aviation problem on which he is most competent to speak with authority as the result of practical experience, namely, the structural details of aeroplanes, propellers, and particularly of internal-combustion engines. In fact, an important feature of the book is that we find here illustrated descriptions of the main features of the principal types of motor, such as the Antoinette, Gnome, Panhard, Wright, and similar information regarding the different leading types of monoplane and biplane. To add to the completeness, tables are

given showing the numerical data (dimensions, weight, horse-power, speed, and so forth), both in regard to motors and aëroplanes. The reader can see at a glance what the present position is with regard to details of construction.

The book is a compilation of useful information, and not a mere exposition of the author's fads; in fact, it is conspicuously free from dogmatic expressions of opinion. Indeed, the author carefully states that "it is not intended that an aëroplane could be designed upon the data contained herein." He has, however, directed attention clearly to the great improvements still required in those details of construction with which he is most conversant. For example, he says:—

"The study of aërial propellers is only in its infancy, and an enormous amount of experimental work remains to be done. The efficiency of present-day designs is abnormally low, and in many cases not more than 50 per cent."

Again, in the chapter on "future developments," we are told:—

"The depreciation of the 1909 flying machine is enormous, the life of the engine is seldom more than 200 miles; in some cases it is a very few miles indeed, and breakdowns or seizures are a constant evil."

The author believes in an internal-combustion turbine. This might obviate the rotatory inertia of the present Gnome motor, which must affect the steering by its gyroscopic action. "Strength of materials" also receives discussion, and derives additional interest from the fact that it is a moot point whether defect in this respect or instability was the cause of certain recent fatalities. Mr. Brewer believes that the flying machine of the future will, like a ship, have living accommodation for passengers and crew; and had he permitted himself to go a little outside his own speciality he would have seen that a necessary condition for progress is the abolition of "ailerons," "gauchissement," or "warping." But the author very wisely fights shy of stability considerations, though he has, on the other hand, an instructive chapter on the art of flying, in which he says:—

"Mr. Rolls has described the initial sensations as those received in driving a motor-car which is skidding in all directions at once."

The details of Henson's model of 1843 show that the conception of an aëroplane is by no means new, but that the want of a sufficiently light and powerful motor is the obstacle which has hitherto prevented its realisation.

As the author carefully disclaims any attempt to deal with mathematical considerations, one cannot, of course, take very serious exception if the few references which he gives are occasionally inaccurate or obscurely stated. It will be sufficient to take a few examples. On p. 12 he says, when speaking of the components of pressure he refers to the lift, as one of them, "and that, acting in a horizontal direction to overcome the skin friction of the machine, this is called the drift," forgetting that in an inclined plane drift exists independently of skin friction. On p. 15 he states Joessel and Aranzini's

formula for the centre of pressure, and proceeds to explain that the coordinate of this point has a maximum value—a conclusion at variance with the formula in question. In the next sentence he speaks of "conditions of stability" where equilibrium is meant. On p. 87 he reminds us of the Irishman who said, "There were five of us; there was myself, that's one, there were the two Flynns, that's two, there was Mike Murphy, that's three," and so on. For of the "five variables" in propeller design, the first is "the speed of the machine and the power available." (This is, however, a trivial objection.) On p. 20 he says that the sum of the sine of a certain angle and the tangent of another angle may be written down as twice the sine or tangent of either angle; but there is no evidence that the angles are meant to be equal or nearly so. And the statement of von Loessl's law of resistance (p. 236) gives  $P = P_0 \sin \alpha$ , whereas on p. 15 we have  $P = 2P_0 \sin \alpha$  with  $\alpha$  small.

Criticisms of a similar character apply with greater force to M. Petit's book (2), for which we have to thank Messrs. Hubbard and Ledebor, editors of the *Aëronautical Journal*, for an English translation.

It would have been better if M. Petit had confined his attention to the theme described by the title "How to Build an Aëroplane," and had not trenched on dangerous ground of a theoretical character. To begin with, the author bases his discussion of thrust on a moving plane on Wegner von Dallwitz's formula. According to this the thrust varies as the tangent-squared of the angle of attack. When this angle is small the thrust would thus become a quantity of the second order of small quantities, and the law would approximate to the "sine-squared" law originally proposed by Newton. That this result is not in accordance with experiment has been sufficiently shown by Langley and others. If in order to cut matters short it is necessary to confine the discussion to one theory of air resistance, the choice is therefore a bad one. English readers will do well to remember that *tg* stands for tangent, otherwise the printing of this in italics, while *sin* and *cos* are in Roman type, may mislead them.

On pp. 22-36, in discussing lateral stability, the author falls into a very common error in regard to the effects of varying the height of the centre of gravity, and when his treatment of the subject contains such statements as that "this application of the centre of gravity is shown in elementary physics by the pendulum," misunderstandings are likely to arise. In reality equilibrium and stability are but little affected by raising or lowering the main planes relatively to the centre of gravity, or, what is the same thing, lowering or raising the centre of gravity relatively to the main planes. If the resultant pressure always acts along a perpendicular to the main planes through their centre of pressure, and if this perpendicular passes through the centre of gravity, it will continue to do so when the aëroplane receives an angular displacement, and there will be no moment tending to right the machine. In this respect an aëroplane differs from a pendulum and a balloon. The matter is a little difficult to make clear, and will

probably have to be explained elsewhere at greater length than is possible in this review; for this reason it is useful to have a name for the result, and I call it the Principle of Independence of Height. It is, of course, liable to modification in consequence of skin friction and other causes. In the meantime, it is an error, into which it is easy to fall, to imagine that because the weight has a moment about the centre of pressure, the *aërodrome* will swing about that point. It will acquire angular momentum about that point by slipping sideways without rotating. To examine the tendency to rotation, moments must be taken about the centre of gravity.

The mistake was indeed a very excusable one, but the wording of such statements as

"The force  $G_1E$  and the angle  $\phi$  produce a component  $O_1D$ ." "Which is the best way to obtain a low centre of gravity? The oldest method was to arrange the planes so that they formed an obtuse dihedral angle,"

hardly tends to make matters clearer.

The book contains much descriptive matter regarding motors, the fuselage, and methods of starting and landing, but the author would have been more convincing if he had been less dogmatic in the chapter on "The Future" in his attacks on the ornithopter and helicopter, and his claims for the monoplane as against the biplane.

We hope the criticisms contained in this review will not deter Messrs. Hubbard and Ledeboer from making further contributions to our *aëronautical* literature. So many books have recently appeared in France of about the same size and character as "How to Build an *Aëroplane*" that English translations are at present particularly useful in giving some insight into the state of progress on the other side of the Channel.

Theoretical considerations of all kinds have been carefully avoided in Mr. Morgan's little book (3) which deals purely with the details of construction of a biplane glider. Now that public attention has been centred on record-breaking flights, it is peculiarly important that the initial requirements for "learning to fly" should be brought before our notice, and the author strongly emphasises in his preface the fact that all our most successful flyers have commenced with gliders before taking to motor-driven machines, the Wright brothers having spent no fewer than three years in gliding flights. The author shows how anyone can build a glider of the type developed by Octave Chanute at a cost for the materials of about 2*l.* or 3*l.*, and it is much to be hoped that the book will induce would-be aviators to start in the right way.

M. Paul Raybaud's pamphlet (4) of twenty-four pages is intended to advance certain views regarding air resistance, such as, for example, that the air resistance on a moving surface does not act normally to the surface, but in a direction determined by the law of equality of action and reaction, that the centre of pressure of a plane area is fixed relative to the plane, that if any area is projected on a plane perpendicular to the line of relative motion, the projection of the centre of pressure is the centre of pressure

of the projection (p. 9), and so forth. The arguments are of a superficial character, such as "it is evident" (p. 9), and when it comes to explaining the behaviour of a plane let fall obliquely (p. 13), he is compelled to introduce a force  $Q$ , which is statically equivalent to admitting a shifting of the centre of pressure, contrary to the previous statements.

Histories of balloons have been published in France at various times, some of them illustrated by grotesque figures of flying machines imagined or proposed. M. G. Besançon has now given us, in a small pocket-book (5), a pretty complete history of the actual development of *aërial* navigation from Galileo's experiments on the density of the atmosphere and Montgolfier's discovery of the balloon down to Blériot's cross-Channel flight. The first section, which deals with balloons, contains a brief account of the construction of their envelopes, of motors and propellers, and a reference to the advantages and disadvantages of various gases for the purpose of inflation.

Profs. Painlevé and Borel (6), on the other hand, condense their historical introduction into the first twenty pages, where they divide the history into four periods, namely, the legendary period, the heroic period, the scientific period, and the industrial period. They discuss the laws of air resistance, and briefly refer to the well-known controversy on the sine law *versus* the sine squared law, and the discussion embraces not only *aéroplanes*, but also bird-flight, ornithopters, and helicopters. Stability is referred to, but not at great length; the property which we have described as the principle of independence of height is, however, mentioned. In an appendix of more than eighty pages, certain elementary applications of mechanical principles are discussed at greater length than would be possible in the text.

The term "*aërial* navigation" is now used in so wide a sense that it is necessary to explain that Prof. Adolf Marcuse's article, "Navigation in der Luft" (7), deals with navigation proper, or the steering of a dirigible by means of charts and geodetic and astronomical observations. It is a general summary of progress made up until the autumn of 1909, in a subject which is much studied in Germany, but is altogether neglected in England. The author distinguishes three methods of place-determination, giving rise to terrestrial, astronomical, and magnetic navigation; of these the first three will be readily understood, while the third embraces not only steering by the compasses, but the determination of position by observation of the magnetic elements and the use of magnetic charts.

We now come to two papers which represent substantial progress in developing mathematical theories of equilibrium and stability. Prof. Marcel Brillouin's paper on metacentric curves and surfaces (8) is an important contribution to the theory of statical equilibrium and stability. When an *aëroplane* is moving uniformly and the lines of action of the resultant thrust are plotted relative to the *aëroplane* for different inclinations of the relative wind these lines will envelop a curve which the author calls the metacentric curve. Diagrams are given of these curves for different arrangements of two planes, showing that they are



of very varied forms, and furnished, as a rule, with eight cusps, four of which correspond to grazing incidence of the air on one or other plane. Into the relative uses of statical and dynamical methods of approaching the problem of stability it is not necessary to enter at great length, although Prof. Brillouin refers to this question in the introduction. It must be pretty evident to anyone who has studied the problem that both methods must be pushed to their ultimate conclusions before aviation is reduced to an exact science; and further, our 1904 papers on dynamical stability were never intended to be final. What Prof. Brillouin has done is to reduce materially the amount of work still remaining to be done in a field of investigation of a new and difficult character.

Exactly the same remarks apply to Prof. Reissner's article (9). The steering of *aéroplanes* in turning curves is a difficult problem, which up to the present has not received the attention that it deserves, with the result that a great deal of an aviator's attention is devoted to counteracting the tendency of *aéroplanes* to turn in circles, or sometimes, not improbably, to describe spirals with decreasing convolutions until, if unchecked, they would twizzle round and fall like the seeds of certain trees. In fact, as Dr. Reissner himself points out in his introduction,

"on the motion in a curved path we find only meagre references, in which it is only attempted to satisfy one equation of equilibrium, instead of considering the six, as is necessary with every body moving in free space."

Dr. Reissner has used approximate methods; for example, in places he assumes the radius of the curve to be large. Anyone working at problems of this class will realise the necessity of employing such methods of approximation in order to reduce the mathematical work to a minimum in the early stages of the investigation. When one is thoroughly familiar with the simplest solutions, it becomes much easier to take account of modifications in which some of the terms previously neglected are re-introduced.

While on the subject of steering, it is interesting to refer to the Dunne biplane, of which a short account is given in the *Aéronautical Journal* for July, and of which a noticeable feature is that the planes actually have a negative angle of attack near the tips, so as to receive a downward pressure there. It is evident that by such a method it is possible to counteract the tendency of most *aéroplanes* to heel over excessively to the inside when rounding curves without making the lift vanish.

The report is before us (10) of the fourth International Congress of *Aéronautics*, which met at Nancy from September 18 to 23, 1909. The attendance at this congress was smaller than one might have expected, the membership list containing just over seventy names, but including Government delegates from the United States, Belgium, France, Italy, and Russia. The congress was divided into three sections, of which the first, devoted to *aërostation*, appears to have given considerable attention to *aéronautical* cartography and navigation proper. In the reports of the

second section (aviation) we find discussions of propeller-thrust, laws of air resistance, the efficiency of motors, and other matters of like character, while the third section was devoted to scientific and other questions of a somewhat more miscellaneous nature.

The interest of the Smithsonian Institution in *aéronautics* dates almost from the commencement of its work, and this interest has been greatly stimulated through the secretaryship of the late Dr. Samuel Pierpont Langley, who brought with him to the institution the nucleus of a library of *aéronautical* literature. A most fitting memorial or tribute to his services to *aéronautics* is afforded by Mr. Paul Brockett's "Bibliography of *Aéronautics*" (11). While primarily intended as a catalogue of the material contained in the Smithsonian collection, this volume of 940 pages will prove a valuable—perhaps an indispensable—work of reference in the hands of every student of *aéronautics*.

A work of reference of a rather more popular character is M. Ventou-Duclaux's "Petite Encyclopédie *aéronautique*" (12). The reader who wishes to follow intelligently the records in the daily Press of aviation meetings and fatalities requires some information regarding the meaning of such terms as Gnome motor, carburettor, Curtiss biplane, Panhard motor, centre of pressure. All such expressions he will find explained if he consults this little dictionary. For some reason "Virage" does not occur.

The "Encyclopædia of Sport" (13), which is to be completed in thirty parts, opens with an article by Lord Montagu of Beaulieu on *aéronautics*. It contains a good, popular account of the subject, well illustrated by photographic reproductions of the chief *aéroplanes* and dirigibles, and of most of the "record" flights, such as Blériot's Channel flight, Paulhan's Manchester flight, and the flights of the principal French and German military dirigibles. The other articles in this number are on "Alligator," "Ammunition," "Angling," "Antelopes" (the last unfinished).

In the *Revue des Sciences* for June, 1908, Captain Paul Renard discussed the problem of the dirigible balloon. In the issues for April last he has given a couple of general articles on the problems of aviation.

Mr. Walter Child, of 35 Alfred Place West, London, S.W., has printed on a small card a diagram showing graphically the results of a new determination of the position of the centre of pressure of a lamina (a rectangular plate of magnalium) for varying angles of attack. According to him the centre of pressure approaches the front edge when the angle of attack vanishes. The method employed was to poise the plate on any assumed axis, to revolve it on a whirling table, and to read off the angle after the plate has come to the position of equilibrium. It may be mentioned that a rough and ready way of demonstrating the shift of the centre of pressure is by loading a rectangular glider and balancing it upon a finger, so that the centre of gravity occupies a known position, and then ascertaining by trial at about what angle the glider will fly if suitably projected. Mr. Child would have been wise to state the length and breadth of his lamina, and in view of the divergence of opinion

regarding the limiting position of the centre of pressure for vanishing inclination, and the probable influence of skin friction, careful examination of the conditions of experiment seems desirable.

We have before us a prospectus, issued last April, of "Aviation Investment and Research, Limited," promoted with a share capital of £100,000, with Major J. A. Meldon and Mr. Ernest Dawe, 33 Southampton Street, as secretaries, a venture the progress of which will be watched with considerable interest.

If there is one inference to be drawn from a survey of the papers mentioned in this review, it is that a large amount of attention has been given to the application of the statical formulæ,  $X=R \cos \alpha$ ,  $Y=R \sin \alpha$ , to problems of lift and drift, but that the other equations of equilibrium or of motion of a solid body have been until now largely left to chance, the skill of the aviator being made to take the place of exact mathematical calculation, with uncertain results. It may be safely stated, however, that the time is not very distant when "equilibrium and stability of aeroplanes" will become a subject suitable for courses of lectures in the mathematical departments of our universities.

G. H. BRYAN.

#### ECONOMIC MYCOLOGY.

*Fungous Diseases of Plants; with Chapters on Physiology, Culture Methods, and Technique.* By Prof. B. M. Duggar. Pp. xii+508. (London: Ginn and Co., n.d.) Price 8s. 6d.

PROF. DUGGAR'S book, although intended primarily for the student in the United States, will be welcomed by the plant pathologist in all countries.

The plan on which the book is arranged is excellent, and the subject-matter is illustrated with 240 drawings and photographs, which are almost all good, while some of the photographs of diseased plants (especially those taken by Prof. H. H. Whetzel) stand out with an excellence which could not be surpassed. In the first fifty pages a full and lucid account is given of isolation and pure-culture methods and the technique of fixing, imbedding, and staining; this is followed by chapters on various physiological phenomena, such as the requirements of fungus spores for germination, aspects of parasitism and saprophytism, and so forth, concluding with a valuable chapter on environmental factors. A short chapter deals with the "principles of disease control," including the preparation of fungicides. This chapter might with advantage have been amplified, and information given on such points as the strength of Bordeaux mixture to be used in potato spraying, the nature of the spray required in the various washes, and the main types of spraying machinery. The information given concerning the lime-sulphur wash is too scanty to be of much practical value. With regard to the fungicidal action of Bordeaux mixture, the statement is made:—

"It has been fairly well demonstrated that the germinating spore will absorb from the nearly insoluble  
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copper compounds of Bordeaux mixture sufficient toxic substances to cause its death."

No account is given of the legislative control of plant diseases, an omission which should be rectified in any future edition. America was the first country to take State action in this direction, and many inter-State regulations controlling the spread of diseases are now in force. At the present time the Government of the United States is considering the best means of putting into force an Act to secure the examination of all plants at the ports of entry in order to prevent the importation of fungus and insect pests.

The remaining part of the book, consisting of 400 pages, describes the various species of fungi and bacteria which are known to cause injury to plants of economic importance in America. The aim of the author has been, in the treatment of each disease, to keep in view three considerations—(1) to describe the pathological effects and other relations of host and parasite; (2) to make clear the life-history of the organism causing the disease; and (3) to indicate the methods of prevention and control. A short bibliography, which will be very valuable to the student in other countries besides America, precedes the account of each disease.

Considering the amount of information which is given on so large a number of diseases, the suggestion that some of the more important diseases might have been given a fuller treatment must seem somewhat ungracious. It is, however, unsatisfactory for a student to be merely told, *e.g.* concerning *Botrytis cinerea*, that "much interesting biological work has been done upon this fungus." The bare statement that follows, *viz.*, "infection frequently fails when conidia germinate directly upon the surface of delicate parts," is likely to be somewhat misleading, since it is not qualified by any reference to the results obtained by Kissling (whose name is quoted in the bibliography), which demonstrated that certain plants can be easily infected in this way. One or two omissions in the list of diseases may be noticed. The mildew (*Sphaerotheca humuli*) which attacks the hop and other plants (but not the rose) in Europe is in the United States commonly found attacking the leaves of roses; no mention is made of this disease, the "mildew" of the rose being attributed entirely to *S. pannosa*, which, in the States, is apparently the less common of the two species. It is curious to find no reference to the "mildew" of the cultivated hop. Another omission is the "covered smut" of barley (*Ustilago hordei*), which is not uncommon in the States. The "crown gall" of lucerne (*Urophlyctis alfalfae*) is found, not only "in South America and Germany," but is known also in Switzerland and Italy, and has occurred in England in Kent.

Except for a few comparatively unimportant omissions, however, this manual is thoroughly comprehensive. Throughout the work there is evidence of much first-hand knowledge of the diseases described. In some cases Prof. Duggar has followed up his researches in the States by paying a visit to Europe to study the same disease there, and in this way he has been able to throw light on certain vexed questions of